



南方科技大学
SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY

Exam: 1+3 Assessment for Dept. Computer Science and Engineering

Time: 19:30–21:00, Jun. 9th, 2021

Duration: 1.5 hours

Part	I	II	III	Total
Points	20	40	40	100

This exam paper contains three parts and the score is 100 points in total. Please hand in your exam paper, answer sheet, and your scrap paper to the proctor when the exam ends.

Part I: Computer Basics

1. (4 points) Name at least four operating systems.
2. (4 points) What is a low-level programming language? Give an example of low-level programming languages.
3. (4 points) What may happen if we compress a compressed file again and again? Will the size become zero if this file is compressed for infinite times?
4. (4 points) List at least two differences between processes and threads.
5. (4 points) Do you think artificial intelligence (AI) can replace or beat human beings in the future? Explain why.

Part II: Programming

6. (5 points) Write a function `getMinValue(int[] numbers)` that returns the smallest element of an array.
7. (5 points) What is “dynamic binding” in Java?
8. (5 points) How are reference-type arguments of methods passed in Java?
9. (5 points) List at least two differences between methods and constructors.
10. (5 points) In a 32-bit microprocessor, assume the machine code of each instruction is 32 bits long and each memory location holds one byte (8 bits), what is the size of required memory to store 1000 instructions?
11. (5 points) What is a Stack and why do Stack Overflow errors occur?
12. (5 points) Given a set of integers, how to find the smallest number in the fastest way? How to find the third smallest number in the fastest way? Briefly describe the data structure and algorithm used.
13. (5 points) Can we override static methods in superclass in Java? Why can we or can't we?

Part III: Logic and Calculation

14. (5 points) In a group of five people, where every two are either friends or enemies, there must be either three mutual friends, or three mutual enemies. Prove this or disprove this by giving a counter example.

15. (10 points) Depending on a , find the eigenvalues of the following two matrices.

(a) $\begin{bmatrix} a & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & a \end{bmatrix}$ (b) $\begin{bmatrix} 0 & 0 & a \\ 0 & 1 & 0 \\ a & 0 & 0 \end{bmatrix}$

16. (10 points) Suppose you are participating in a game show and you are asked to choose one of three doors: one of them has a car behind it; the remaining two have goats behind them. You choose one door, assuming it is door number one, and then the host, who knows what is behind the door, opens the other door with the goat behind it, assuming it is door number three. He then asks you, "Do you want to choose door number two?" Would it be an advantage for you to vary your choices? What is the possibility of winning a car if you choose to change and why?
17. (10 points) There are five people, four of them are fickle (善变的), one is honest. The definition of fickle is: the first time you ask him a question, he may tell the truth or lie. The second time you ask him again, the one who told truth tells lies now, and the liar tells the truth. Now you are allowed to ask two questions to determine which person is honest, how to ask? The two questions can ask the same person or different ones.

18. (5 points) There is a positive integer:

- When it divides 2, the remainder is 1.
- When it divides 3, the remainder is 2.
- When it divides 4, the remainder is 3.
- When it divides 5, the remainder is 4.
- When it divides 6, the remainder is 5.
- When it divides 7, the remainder is 6.
- When it divides 8, the remainder is 7.
- When it divides 9, the remainder is 8.
- When it divides 10, the remainder is 9.

This number is not small, but it is not big either. Give the smallest number that has these characteristics.



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Exam: Turing Class Assessment

Time: 21:00–22:00, Jun. 9th, 2021

Duration: 1 hour

Question	1	2	3	4	5	6	Total
Points	10	15	10	15	20	30	100

This exam paper contains six questions and the score is 100 points in total. Please hand in your exam paper, answer sheet, and your scrap paper to the proctor when the exam ends.

- (10 points) How many triples of the form (i, j, k) with $1 \leq i < j < k \leq 20$ are there?
- (15 points) How many solutions are there to the equation $x_1 + x_2 + x_3 = 15$, where x_1, x_2 , and x_3 are all nonnegative (≥ 0) integers?

- (10 points) (a) What will be printed in the program below?

```
1 String str;
2 System.out.println(str.length());
```

- (b) What will be printed in the program below?

```
1 String str = "Hello World!";
2 System.out.println(str.length());
```

- (15 points) Check if the following vectors are linear independent.

(a) $v_1^T = (1, 2)$ and $v_2^T = (-1, -2)$.

(b) $v_1^T = (1, 3, 0, 2)$, $v_2^T = (3, 9, 2, 8)$, and $v_3^T = (5, 10, 7, 12)$.

- (20 points) We have 100 bottles of water; one of them is poisonous. Suppose the rat will die after seven days after it drank the poisonous water. Now, give you seven days, how many rats do you need (at least) to find the poisonous bottle? Why?

- (30 points) Recall that the Fibonacci sequence is the numbers $0, 1, 1, 2, 3, 5, 8, 13, \dots$, which can be described by the recursive formula:

$$F_0 = 0; F_1 = 1; F_n = F_{n-1} + F_{n-2}$$

for all $n \geq 2$. Clearly, $F_n \leq 2F_{n-1} \leq 2^n$.

- (a) Consider the following algorithm for computing F_n :

```
if n=0 then
| return 0
else if n=1 then
| return 1
else
| return Fibo(n-1) + Fibo(n-2)
end
```

Algorithm 1: Fibo(n : a nonnegative integer)

Please analyze its running time in terms of big-O notation. Is it polynomial-time or exponential?

- (b) Can you improve the above algorithm? Write down your algorithm, and analyze both the time complexity and space complexity.